Bukti Korespondensi Author

A. PAPER 6:	**Integrated Analytical Hierarchy Process and Objective Matrix in Balanced Scorecard Dashboard Model for Performance Measurement** **Okfalisa*1, Septia Anugrah2, Wresni Anggraini3, Muhammad Absor4, S.S.M. Fauzi5, Saktioto6** **TELKOMNIKA, Vol.16, No.6, December 2018**

Bukti korespondensi author pada paper ini tidak dapat dilacak secara lengkap. Namun proses Accepted diterima pada tanggal 6 Juni 2018, dan Full published pada Desember 2018.

Bukti Korespondensi dapat dilihat pada Gambar berikut dan lengkapnya dapat dilihat pada lampiran:

1. Email Full accepted diterima oleh penulis pada 6 Juni 2018. Dan full published pada Desember 2018.

---------- Forwarded message ----------
From: Assoc. Prof. Dr. Tole Sutikno <tole@journal.uad.ac.id>
Date: Wed, 6 Jun 2018, 20:19
Subject: [TELKOMNIKA] Editor Decision
To: Okfalisa Okfalisa <okfalisa@gmail.com>

Okfalisa Okfalisa:

We have reached a decision regarding your submission to TELKOMNIKA (Telecommunication Computing Electronics and Control), "Integrated AHP and OMAX in Balanced Scorecard Dashboard Model for Performance Measurement Tools".

It is our policy that all submitted papers in this year is reviewed and considered for 2018 International Conference and Workshop on Telecommunication, Computing, Electronics and Control (2018 ICW-TELKOMNIKA, http://journal.uad.ac.id/index.php/TELKOMNIKA/pages/view/conference). Corresponding author of the accepted paper will be invited to present his/her work in this conference. There is no proceeding for the ICW TELKOMNIKA international conference. We will be only prepare book abstract & seminar kit. Then, all accepted and presented papers (after revisions based upon feedback at the conference & scientific writing workshop, if necessary) will be published on TELKOMNIKA Telecommunication, Computing, Electronics and Control (Scopus indexed journal, Q3) or our other Scopus indexed journals.

Based on our initial fast review, your paper need some improvements to be considered for next step review.

1. Please re-read our instructions (at: http://journal.uad.ac.id/index.php/TELKOMNIKA/about/editorialPolicies#custom-1) carefully and follow the checklist strictly, as any spelling mistakes and errors may be translated into the typeset version.

2. You should improve your analyzing and present comparison of your results to those obtained in similar studies. The "result and discussion" section reports the most important findings, including analysing results as appropriate. Results given in figures should not be repeated in tables. It is very important to prove that your manuscript has a significant value and not trivial.

3. Please re-check that all references are already cited in your article, and order of your citation is SEQUENTIAL [1], [2], [3], [4], ... (NOT random)

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A good research paper has a clear statement of the problem the paper is addressing, the proposed solution(s), and results achieved. It describes clearly what has been done before on the problem, and what is new. Submit your revised paper as soon (within 15 days) through our online system at the same paper ID (as author version). When your first revised paper reached us, it will be reviewed by minimum three (3) independent reviewers based on the following criteria: Relevance, Significance, Novelty, Technical correctness, Experimental/evidential support, Clarity of presentation and Reference to prior work and publications. The Editor shall inform you of the results of the review as soon as possible. All correspondence, including notification of the Editors' decision and requests for revisions, will be sent by email.

Your cooperation is very appreciated.

Thank you,

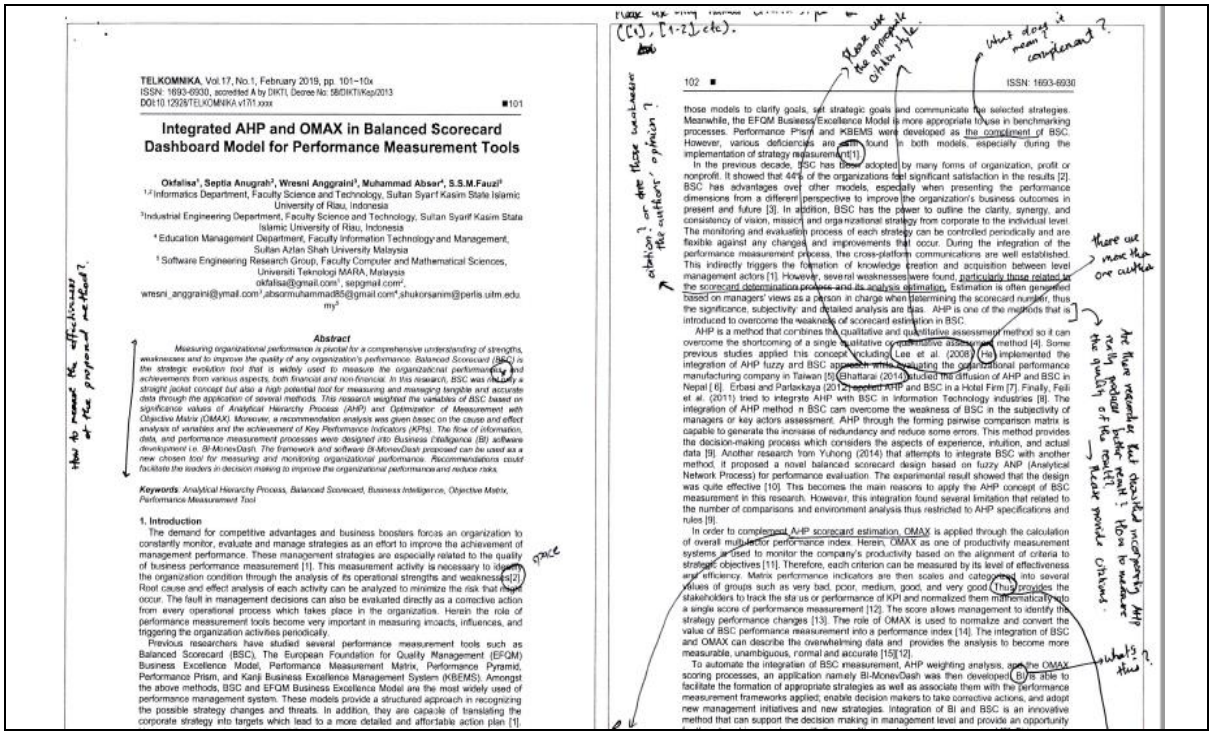
Sincerely yours,
Tole Sutikno, Ph.D.
General Chair, 2018 ICW-TELKOMNIKA
Editor-in-Chief, TELKOMNIKA Telecommunication, Computing, Electronics and Control (Scopus indexed journal, Q3)
email: tole@journal.uad.ac.id

Editor-in-Chief, International Journal of Power Electronics and Drive Systems (Scopus indexed journal, Q3)

Our events:

International Conference and Workshop on Telecommunication, Computing, Electronics and Control (ICW-TELKOMNIKA), September 18-21, 2018 in Yogyakarta, Indonesia

2. Contoh hasil correction sesuai dengan commentar reviewer dapat dilihat pada Gambar dibawah. Lengkapnya dapat dilihat pada **Lampiran** atau di Link:



TELKOMNIKA, Vol.17, No.1, February 2019, pp. 101~10x
ISSN: 1693-6930, accredited A by DIKTI, Decree No: 58/DIKTI/Kep/2013
DOI:10.12928/TELKOMNIKA.v17i1.xxxx

Integrated AHP and OMAX in Balanced Scorecard Dashboard Model for Performance Measurement Tools

Okfalisa[1], Septia Anugrah[2], Wresni Anggraini[3], Muhammad Absar[4], S.S.M.Fauzi[5]
[1,2] Informatics Department, Faculty Science and Technology, Sultan Syarif Kasim State Islamic University of Riau, Indonesia
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Abstract

Measuring organizational performance is pivotal for a comprehensive understanding of strengths, weaknesses and to improve the quality of any organization's performance. Balanced Scorecard (BSC) is the strategic evolution tool that is widely used to measure the organizational performance and achievements from various aspects, both financial and non-financial. In this research, BSC was not only a straight jacket concept but also a high potential tool for measuring and managing tangible and accurate data through the application of several methods. This research weighted the variables of BSC based on significance values of Analytical Hierarchy Process (AHP) and Optimization of Measurement with Objective Matrix (OMAX). Moreover, a recommendation analysis was given based on the cause and effect analysis of variables and the achievement of Key Performance Indicators (KPIs). The flow of information, data, and performance measurement processes were designed into Business Intelligence (BI) software development i.e. BI-MonevDash. The framework and software BI-MonevDash proposed can be used as a new chosen tool for measuring and monitoring organizational performance. Recommendations could facilitate the leaders in decision making to improve the organizational performance and reduce risks.

Keywords: *Analytical Hierarchy Process, Balanced Scorecard, Business Intelligence, Objective Matrix, Performance Measurement Tool*

1. Introduction

The demand for competitive advantages and business boosters forces an organization to constantly monitor, evaluate and manage strategies as an effort to improve the achievement of management performance. These management strategies are especially related to the quality of business performance measurement [1]. This measurement activity is necessary to identify the organization condition through the analysis of its operational strengths and weaknesses[2]. Root cause and effect analysis of each activity can be analyzed to minimize the risk that might occur. The fault in management decisions can also be evaluated directly as a corrective action from every operational process which takes place in the organization. Herein the role of performance measurement tools become very important in measuring impacts, influences, and triggering the organization activities periodically.

Previous researchers have studied several performance measurement tools such as Balanced Scorecard (BSC), The European Foundation for Quality Management (EFQM) Business Excellence Model, Performance Measurement Matrix, Performance Pyramid, Performance Prism, and Kanji Business Excellence Management System (KBEMS). Amongst the above methods, BSC and EFQM Business Excellence Model are the most widely used of performance management system. These models provide a structured approach in recognizing the possible strategy changes and threats. In addition, they are capable of translating the corporate strategy into targets which lead to a more detailed and affordable action plan [1].

those models to clarify goals, set strategic goals and communicate the selected strategies. Meanwhile, the EFQM Business Excellence Model is more appropriate to use in benchmarking processes. Performance Prism and KBEMS were developed as the complement of BSC. However, various deficiencies are also found in both models, especially during the implementation of strategy measurement[1].

In the previous decade, BSC has been adopted by many forms of organization, profit or nonprofit. It showed that 44% of the organizations feel significant satisfaction in the results [2]. BSC has advantages over other models, especially when presenting the performance dimensions from a different perspective to improve the organization's business outcomes in present and future [3]. In addition, BSC has the power to outline the clarity, synergy, and consistency of vision, mission and organizational strategy from corporate to the individual level. The monitoring and evaluation process of each strategy can be controlled periodically and are flexible against any changes and improvements that occur. During the integration of the performance measurement process, the cross-platform communications are well established. This indirectly triggers the formation of knowledge creation and acquisition between level management actors [1]. However, several weaknesses were found, particularly those related to the scorecard determination process and its analysis estimation. Estimation is often generated based on managers' views as a person in charge when determining the scorecard number, thus the significance, subjectivity and detailed analysis are bias. AHP is one of the methods that is introduced to overcome the weakness of scorecard estimation in BSC.

AHP is a method that combines the qualitative and quantitative assessment method so it can overcome the shortcoming of a single qualitative or quantitative assessment method [4]. Some previous studies applied this concept including Lee et al. (2008) [5] implemented the integration of AHP fuzzy and BSC approach while evaluating the organizational performance manufacturing company in Taiwan [5]. Bhattarai (2014) studied the diffusion of AHP and BSC in Nepal [6]. Erbasi and Partakkaya (2012) applied AHP and BSC in a Hotel Firm [7]. Finally, Feili et al. (2011) tried to integrate AHP with BSC in Information Technology industries [8]. The integration of AHP method n BSC can overcome the weakness of BSC in the subjectivity of managers or key actors assessment. AHP through the forming pairwise comparison matrix is capable to generate the increase of redundancy and reduce some errors. This method provides the decision-making process which considers the aspects of experience, intuition, and actual data [9]. Another research from Yuhong (2014) that attempts to integrate BSC with another method, it proposed a novel balanced scorecard design based on fuzzy ANP (Analytical Network Process) for performance evaluation. The experimental result showed that the design was quite effective [10]. This becomes the main reasons to apply the AHP concept of BSC measurement in this research. However, this integration found several limitation that related to the number of comparisons and environment analysis thus restricted to AHP specifications and rules [9].

In order to complement AHP scorecard estimation, OMAX is applied through the calculation of overall multi-factor performance index. Herein, OMAX as one of productivity measurement systems is used to monitor the company's productivity based on the alignment of criteria to strategic objectives [11]. Therefore, each criterion can be measured by its level of effectiveness and efficiency. Matrix performance indicators are then scales and categorized into several values of groups such as very bad, poor, medium, good, and very good. Thus provides the stakeholders to track the status or performance of KPI and normalized them mathematically into a single score of performance measurement [12]. The score allows management to identify the strategy performance changes [13]. The role of OMAX is used to normalize and convert the value of BSC performance measurement into a performance index [14]. The integration of BSC and OMAX can describe the overwhelming data and provides the analysis to become more measurable, unambiguous, normal and accurate [15][12].

To automate the integration of BSC measurement, AHP weighting analysis, and the OMAX scoring processes, an application namely BI-MonevDash was then developed. BI is able to facilitate the formation of appropriate strategies as well as associate them with the performance measurement frameworks applied; enable decision makers to take corrective actions, and adopt new management initiatives and new strategies. Integration of BI and BSC is an innovative method that can support the decision making in management level and provide an opportunity

2018 1st International Conference and Workshop on Telecommunication, Computing, Electrical, Electronics and Control (ICW TELKOMNIKA 2018)

RESPONSE TO MENTOR(S) COMMENTS

ID Paper : 9648
Tittle : Integrated Analytical Hierarchy Process and Objective Matrix in Balanced Scorecard Dashboard Model for Performance Measurement
Authors : Okfalisa, Septia Anugrah, Wresni Anggraini, Muhammad Absor, S.S.M.Fauzi, Saktioto

1. Mentor's Comment #1 : Title

Title is OK.

I have some minor comments and suggestions, which I annotated in a printed manuscript. A general comment is to avoid abbreviating unnecessarily. If you have to abbreviate, provide the longer version first and then the abbreviation. Please use the appropriate citation style according to the template and user's guidelines.

Respond to Comment #1 :
New Title
Integrated Analytical Hierarchy Process and Objective Matrix in Balanced Scorecard Dashboard Model for Performance Measurement

2. Mentor's Comment #2 : Abstract

Abstract is OK.

However, it is not clear to me how the authors measure the effectiveness of their method.

Respond to Comment #2 :

"However, it is not clear to me how the authors measure the effectiveness of their method" → has been discussed with mentor during the coaching session in Jogyakarta.

Measuring organizational performance is pivotal for a comprehensive understanding of strengths,

Objective Matrix (OMAX). Moreover, a recommendation analysis was given based on the cause and effect analysis of variables and the achievement of Key Performance Indicators (KPIs). The flow of information, data, and performance measurement processes were designed into Business Intelligence (BI) software development i.e. BI-MonevDash. The framework and software BI-MonevDash proposed can be used as a new chosen tool for measuring and monitoring organizational performance. Recommendations could facilitate the leaders in decision making to improve the organizational performance and reduce risks.

3. Mentor's Comment #3 : Introduction

Are there researches that showed that incorporating AHP really produces better results? How to make certain that the result is better (measurement)?

It seems that AHP and OMAX has been combined before in previous work. Then what are the contributions of the current paper?

In the end of Introduction, the authors should tell the reader what is being accomplished in the paper, how it is different from previous work, and what are the contributions of the paper.

Respond to Comment #3 :

Has been discussed with mentor and revise the introduction based on mentor suggestion in file PDF. 9648 comments

1. Introduction

The demand for competitive advantages and business boosters forces an organization to constantly monitor, evaluate and manage strategies as an effort to improve the achievement of management performance. These management strategies are especially related to the quality of business performance measurement [1]. This measurement activity is necessary to identify the organization condition through the analysis of its operational strengths and weaknesses [2]. Root cause and effect analysis of each activity can be analyzed to minimize the risk that might occur. The fault in management decisions can also be evaluated directly as a corrective action from every operational process which takes place in the organization. Herein the role of performance measurement tools become very important in measuring impacts, influences, and triggering the organization activities periodically.

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structure but also the result of analysis using graphical demonstration such as a graph, dashboard, and strategy map [3] so that the cascading of strategic objectives are clearly identified. Previous studies have proven that BI is the most successful method of presenting and following the performance measurement using BSC concept [3,16,17]. Herein four BSC perspectives are explained in more detail and measurable. Recommendations are given as corrective action against the performance achievements. This will aid management level in decision making, monitoring and evaluating performance periodically. To scope this research, a case study is conducted at University X based on data reported in 2015

4. Mentor's Comment #4 : Method

Section 2 (Research Method in the paper) is not required in scientific publication, even though it is needed in thesis. What is needed is a detailed description of the proposed method. However, in the paper the authors call this results and analysis. Please correct this.

3.1, 3.2, 3.3, 3.4, and 3.5 are actually description of the proposed method. However, the authors focus more on the case study instead of the explanation of their proposed method.

Respond to Comment #4 :

Has revise the method as mentor suggestion.

For the purpose of implementing this research, several stages were developed as depicted in Figure.1.

KESIMPULAN:

Paper 6 telah melampirkan bukti korespondensi pengusul dengan pihak editor jurnal.

LAMPIRAN 6

BUKTI KORESPONDING AUTHOR

6. Integrated Analytical Hierarchy Process and Objective Matrix in Balanced Scorecard Dashboard Model for Performance Measurement

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TELKOMNIKA, Vol.16, No.6, December 2018

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A good research paper has a clear statement of the problem the paper is addressing, the proposed solution(s), and results achieved. It describes clearly what has been done before on the problem, and what is new. Submit your revised paper as soon (within 15 days) through our online system at the same paper ID (as author version). When your first revised paper reached us, it will be reviewed by minimum three (3) independent reviewers based on the following criteria: Relevance, Significance, Novelty, Technical correctness, Experimental/evidential support, Clarity of presentation and Reference to prior work and publications. The Editor shall inform you of the results of the review as soon as possible. All correspondence, including notification of the Editors’ decision and requests for revisions, will be sent by email.

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TELKOMNIKA (Telecommunication Computing Electronics and Control)
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[5] Software Engineering Research Group, Faculty Computer and Mathematical Sciences, Universiti Teknologi MARA, Malaysia
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2. Research Method

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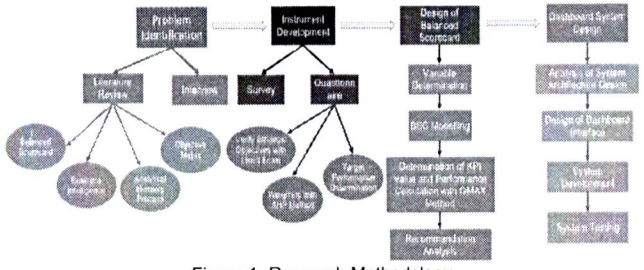

Figure 1. Research Methodology

Research problems were identified by reviewing some literatures and conducting interviews. The literatures were reviewed based on subjects related to performance measurement, performance measurement tools, BSC, KPI, BI and systems development, AHP, and OMAX. In order to reinforce the concept of theory construction, some interviews with top management level (four persons employed as Dean and Deputy Dean) at an X University were conducted as case study. Face to face and semi-structured interviews were accomplished which discussed and explored information related to business processes and organizational developments, strategic plans, frequently faced issues, targets achievements, as well as efforts to address any changes and strategy issues in the organization.

The instrument was developed in form of observation tools and questionnaires. A preliminary study, some information from the case study was obtained including organizational business process data, organizational structure, organizational strategic plan 2013-2033 and operational plan and organizational achievement 2013-2018, performance documents and portfolio. Three questionnaires were designed and distributed to X University. The first questionnaire aimed to validate strategic target variables which were formulated based on the organization's vision and mission. Herein, a 5-scale Linkert was applied as an optional choice of respondents agreed. As the result, twenty variables were proposed in four perspective of BSC. Meanwhile, the second questionnaire was used to determine the weight or significance level of each variable through the application of AHP method. Twenty variables were tested and compared thus then ranked based on the significance level and weight. The third questionnaire was used to set the performance targets and achievements of twenty variables. These questionnaires were answered by management level from top to middle in accordance with the desired targets and consideration of previous year achievements.

Next step, BSC design was developed in four phases [2], including Collection and Documentation of Current System; Balanced Scorecard Modelling; Determining Measurement Values; Analysis Report, management initiatives, and activities.Herein, manual analysis of BSC, AHP, and OMAX concepts was transformed into automated BI-Monevdash. BI-Monevdash followed Object Oriented model for Analysis and Design. UML was used as a tool in describing the interaction between objects into the development of use cases, class diagrams, and activity diagrams. This BI-Monevdash then was tested using black-box, white-box, characteristic test and User Acceptance Test (UAT).

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This section should be renamed Proposed Method,
→ where the method is presented and discussed in detail.

3. Results and Analysis

3.1. Balanced Scorecard Design

As mention before, 20 variables were derived from each BSC perspective and thus acted as strategic objectives. For BSC-Financial perspective, there were five variables, namely FST-01: Increasing the amount of budget allocation, FST-02: Maximizing the realization of budget, FST-03: Increasing budget allocation for Tridharma Perguruan Tinggi (Teaching, Research and Community Services), FST-04: Increasing budget allocation for facilities and infrastructure, and finally FST -05: Increasing budget allocation to improve the quality of human resources and development. Through the BSC-Customer perspective, five variables included: FT-06: Increasing the number of student enrollment, FST-07: Shortening the average of student's study period, FST-08: Increasing the average of student's cumulative grade point average (CGPA), FST-09: Achieving the adequacy ratio of lecturers, and finally, FST-10: Increasing the number of student activities. BSC-Internal Business Process included FST-11: Achieving the adequacy ratio of academic staff, FST-12: Increasing the number of research, FST-13: Increasing the number of community service activities, FST-14: Improving management data and repository through wide world network technologies, and finally was FST-15: Increasing the number of books, lecturers and teaching modules and slides. For BSC-Learning and Growth perspective included variable FST-16: Enhancing the cooperation with internal strategic partners. FST-17: Improving cooperation with external strategic partners. FST-18: Increasing the number of training for employees and lecturers. FST-19: Increasing the number of lecturers with master and doctoral degrees, and finally FST-20: Improving academic forums activities towards national and international conferences.

The above variables were verified and justified through the analysis of the first questionnaire and can be accepted with an 88% agreeable percentage. Next, data related to the strategic objectives, KPI determination, target achievements were then formulated into BSC modeling as described in Figure 2. A cause and effect relationship between variables was mapped toward the strategic map as shown in Figure 3.

Figure 3.

Please improve the quality of the figures

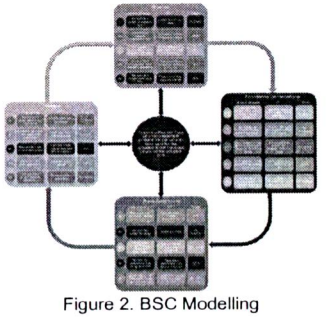

Figure 2. BSC Modelling

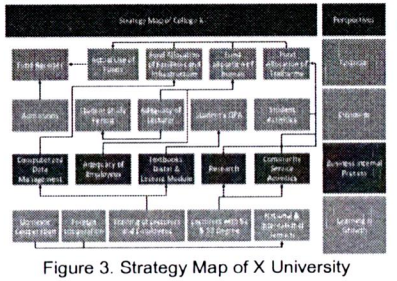

Figure 3. Strategy Map of X University

The strategy map explained that in learning and growth perspectives, the increasing of variable FST-16 (Enhancing the cooperation with internal strategic partners) and FST-17 (Improving cooperation with external strategic partners) affects the increase of FST-20 (Improving academic forums activities towards national and international conferences). The effects can be shown through the involvement of sponsorship, promotion, committee, participants, and keynote speakers which are very potential for the success of academic forums. The increasing number of training for employees and lecturers (FST-18) provided the significant values on the numbers of textbooks, modules as the outcome of the knowledge development activities. Then, the increasing number of lecturers with master and doctoral degrees in FST-19 will influence numbers of research in FST-12 and number of community service activities (FST-13) which also triggers the increase of students' research activities in FST-10 and budget allocation for Tridharma in FST-03. The similar explanation provided in the Figure for other perspectives.

3.2. Determining the Measurement Value

Referring to the development and analysis of BSC modeling and the strategy map, it then continued by determining the measurement values using AHP calculation. As the result of the second questionnaire, the weights of each variable is measured in their significances. The result of CR and CI values are smaller than 0.1 which indicates that the overall perspectives and variables are accepted and consistent. The summarization of vector eigenvalue per perspectives and overall KPIs can be seen in Table 1. The significance of the BSC variables are analyzed and identified through the AHP application, creating a new contribution based on the company or organizations preferences.

Table 1. AHP Weighted and OMAX Scoring Level Summary of Perspectives

Perspective	Priority Value (Eigen Vector)	Variable	Priority Value (Eigen Vector)-Local	Priority Value (Eigen Vector)-Global	OMAX Level	Category	Index
Financial	0,195	FST-1	0,140	0,027	8	Very good	5,176 (Average)
		FST-2	0,118	0,023	0	Review	
		FST-3	0,184	0,036	5	Average	
		FST-4	0,140	0,027	2	Bad	
		FST-5	0,419	0,082	4	Average	
Customer	0,149	FST-6	0,055	0,008	3	Bad	7,873 (Good)
		FST-7	0,274	0,041	10	Perfect	
		FST-8	0,274	0,041	3	Bad	
		FST-9	0,321	0,048	7	Good	
		FST-10	0,077	0,011	10	Perfect	
Internal Business Process	0,231	FST-11	0,108	0,025	3	Bad	4,544 (Average)
		FST-12	0,388	0,090	5	Average	
		FST-13	0,138	0,032	0	Review	
		FST-14	0,165	0,038	10	Perfect	
		FST-15	0,201	0,046	3	Bad	
Learning and Growth	0,425	FST-16	0,134	0,057	0	Review	3,22 (Bad)
		FST-17	0,154	0,065	6	Good	
		FST-18	0,187	0,079	5	Average	
		FST-19	0,311	0,132	3	Bad	
		FST-20	0,214	0,091	2	Bad	

Table 1 explained that from four BSC perspectives, learning and growth became the highest significance perspective with the eigenvector value in 0.425, followed by the internal business process perspective in 0.231, financial perspective in 0.195 and customer perspective in 0.149. Meanwhile, the weighting for each perspective is also defined according to local and global vector eigenvalues.

Based on the local vector eigenvalues in financial perspectives, FST-05 provided the highest significance weight (0.419) and FST-02 as the lowest one (0.118). For customer perspectives, FST-09 became the highest essential weight in 0.321 and FST-06 as the lowest one in 0.055. For the internal business process perspective, FST-12 provided the uppermost considerable weight in the 0.388 and FST-11 as the undermost one in 0.108. For growth and development perspectives, FST-19 became the uppermost significant weight in 0.311 and FST-16 as the bottommost significant weight in 0,134. Based on the global vector eigenvalues, FST-19 became the superior priority weight in 0,132 and FST-6 as the inferior one in 0.008.

Complementing BSC and AHP analysis, the calculation of scoring with OMAX was accordingly conducted to carry on the analysis. By applying the OMAX leveling formula: $\Delta X_{L-H} = \frac{Y_H - Y_L}{X_H - X_L}$, the interval values between high to low level can be defined. As of, the level performance achievement was then quantitatively measured. Herein, the OMAX fulfills the limitation of AHP and BSC for analysis.

Recapitulation on the calculation values, scoring levels, categories, and performance index was obtained based on data reported in 2013, 2014 and 2015 which is compared to target value achievements in 2016. Table 1 found that the performance index of X Unversity in

financial perspective lies in the "average" category with a weight index in 5.176. The customer perspective stands in the "good" category with weight index is 6.744. The internal business process perspective is in the "average" category with weight index in 4.544. Finally, the growth and learning perspective is in the "bad" category with weight index is 3.22. The average overall performance at X University is at a score of 5 with an "average" performance index.

By rooting the cause and effect analysis of each KPIs and performance index achievement, the recommendations were proposed as shown in Table 2. This table explained the recommendation for performance index lies on categories in "bad" and "review". As an example, FST-02 which category is in "review" found that the achievement of budget realization is 100%. The recommendation proposed management level to maintain this achievement. The FST-04 performance index in the "bad" category was due to the reduction of budget allocation achievement for facilities and infrastructures. The strategy changes to subsidize the budget for Tridharma. As a recommendation, the management level needs to stay focus on organizational and strategic objectives thus setting the budget allocation in alignment with it.

Table 2. Root Cause and Recommendation

No KPI	Category	Root Causes	Recommendation
FST-2	Review	Percentage of funds utilization is at 100% or maximum	Maintain the realization of the use of funds at 100% percentage.
FST-4	Bad	The percentage of allocation of funds for facilities and infrastructure was reduced to increase the percentage of fund allocation for *Tridharma* and human resources activities.	Increase fund allocation for the development of *Tridharma* and human resources activities.
⋮	⋮	⋮	⋮
FST-20	Bad	The number of national and international seminars has not increased significantly.	Increase the number of national and international seminars to develop and disseminate knowledge of the academic community of UIN Suska FST.

3.3. Analysis and BI-Monevdash Design

BI-Monevdash application is built by following the entire stages in BSC, AHP, and OMAX. The software architecture design can be seen in Figure 4.

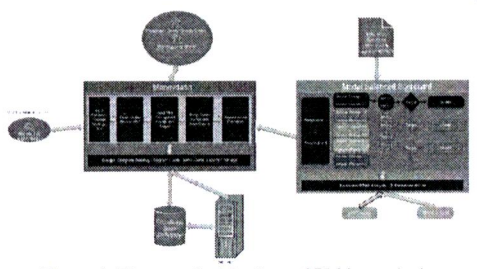

Figure 4. Diagram Architecture of BI-Monevdash

Mechanism of BSC analysis and modeling which is then integrated with AHP for KPIs weighting and OMAX for performance index measurement become the main components in BI-Monevdash development. The architecture diagram informed the flow data process transaction in and out components and key actors for every level stages. Any data such a perspective analysis data, strategic target data, strategy maps, interest values data, organizational profiles, user data, weighted results data, and process, and scoring data are restored and managed in knowledge base repository in connection with the server. The server is developed by applying apache components and MySQL database. The connection to a client PC, web browser, and

serial printers supported server activities. The users are involved as key actors in this application are divided into three categories, namely middle manager including the head of the administration office, head of department and secretary as a person in charge. The software administrator acts as system operator. Meanwhile, the top manager is dean and deputy dean. This application is designed to be as interactive as possible by allowing users to interact directly or indirectly in the monitoring and evaluating progress on the performance. The recommendations and corrective action was given as an evaluation, management control and to reduce the emerging risks during the strategy execution. Performance measurement, process, and result analysis are reported in forms of Gauge, Bar chart, Line chart, table, and dashboard model.

3.4. Implementation of BI-Monevdash

The interface of BI-Monevdash can be seen in Figures 5. It shows the performance index of four perspectives according to data analysis in Table 2, where for financial perspective the performance index in the "average" category and score 5.176; perspective of customer performance index in the "good" category with a score of 6.744; perspective of internal business processes performance index in the "average" category with a score of 4.544; and the last, learning and growth perspective with a "bad" performance index with a score of 3.22. Meanwhile, the general performance index of overall data is scored in 5 and in the "average" category. The dashboard description for BSC modeling analysis is then explained in Figure 6. Herein, the performance index and level of KPIs (FST-01, FST-02, FST-03, FST-04, and FST-05) in Financial perspective are declared as an example.

3.5. Testing of BI-Monevdash Application

White-box testing was conducted using several techniques such as a flowgraph, Cyclomatic Complexity (CC) calculation, independent path determination, and a test case. From 55 nodes, the flowgraph obtains the systematic complexity value that is running 11 test cases thus indicates that BI-Monevdash application has a complex procedure and moderate risk. This test cases value interprets that white box testing is a success. In Black-box testing, equivalence class partitioning technique was conducted thus the entire functions in the application can run as well as expected. Finally, dashboard characteristic testing was conducted to determine the feasibility and specification of the system towards dashboard characteristics. The testing was conducted by disseminating the questionnaire to several top managers as respondents. The questionnaire applied scale Linkert 5. As the result, 89% of respondents strongly agree with the suitability of BI-Monevdash system with dashboard characteristics. As well as UAT testing proposed the result that BI-Monevdash application can be well-accepted by end-users.

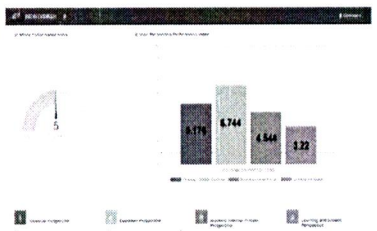

Figure 5. The interface of BI-Monevdash for the General X University Performance

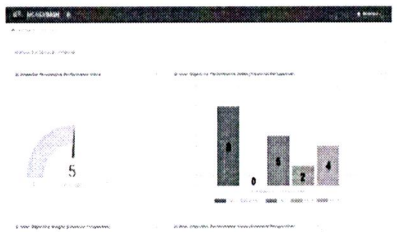

Figure 6. The interface of BSC Modeling Analysis for the Financial Perspectives

4. Conclusion

From the series of methodologies applied in this research, it can be concluded that the BSC implementation model with integration of AHP and OMAX has been successfully in measuring the performance X university strategy. The implementation of this concept can contribute to the development of new technique for performance measurement tools and address the various weaknesses of BSC concepts in measurement. AHP Weighting provides an opportunity to prioritize KPIs variable of perspective thus the significance of the data is clearly

evident within leveling and scoring of performance. The application of OMAX extends the completeness and accuracy of calculation leveling and scoring of performance measurement. The root cause analysis of this model become the bases for proposing the recommendation towards any changes and activities that occurred. Therefore, it can be used for evaluation and monitoring to control any achievements during the strategy execution. The prototype of BI-Monevdash has successfully developed an automated and computerized BSC-AHP and OMAX modeling software. The dashboard and graphical display of information and analysis come to the aid of the stakeholders involved in monitoring and evaluating the execution of their strategy. A series of software testing has been performed in ensuring the prototype of BI-Monevdash can be used properly as one of the performance measurement tools for both profit and nonprofit companies.

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TELKOMNIKA, Vol.17, No.1, February 2019, pp. 101~10x
ISSN: 1693-6930, accredited **A** by DIKTI, Decree No: 58/DIKTI/Kep/2013
DOI:10.12928/TELKOMNIKA.v17i1.xxxx

2018 1st International Conference and Workshop on Telecommunication, Computing, Electrical, Electronics and Control (ICW TELKOMNIKA 2018)

RESPONSE TO MENTOR(S) COMMENTS

ID Paper : 9648
Tittle : Integrated Analytical Hierarchy Process and Objective Matrix in Balanced Scorecard Dashboard Model for Performance Measurement
Authors : Okfalisa, Septia Anugrah, Wresni Anggraini, Muhammad Absor, S.S.M.Fauzi, Saktioto

1. Mentor's Comment #1 : Title

Title is OK.

I have some minor comments and suggestions, which I annotated in a printed manuscript. A general comment is to avoid abbreviating unnecessarily. If you have to abbreviate, provide the longer version first and then the abbreviation. Please use the appropriate citation style according to the template and user's guidelines.

Respond to Comment #1 :
New Title
Integrated Analytical Hierarchy Process and Objective Matrix in Balanced Scorecard Dashboard Model for Performance Measurement

2. Mentor's Comment #2 : Abstract

Abstract is OK.

However, it is not clear to me how the authors measure the effectiveness of their method.

Respond to Comment #2 :

"However, it is not clear to me how the authors measure the effectiveness of their method" → has been discussed with mentor during the coaching session in Jogyakarta.

Measuring organizational performance is pivotal for a comprehensive understanding of strengths, weaknesses and to improve the quality of any organization's performance. Balanced Scorecard (BSC) is the strategic evolution tool that is widely used to measure the organizational performances, and achievements from various aspects, both financial and non-financial. In this research, BSC was not only a straight jacket concept but also a high potential tool for measuring and managing tangible and accurate data through the application of several methods. This research weighted the variables of BSC based on significance values of Analytical Hierarchy Process (AHP) and Optimization of Measurement with

Received September 5, 2017; Revised December 28, 2018; Accepted January 12, 2019

Objective Matrix (OMAX). Moreover, a recommendation analysis was given based on the cause and effect analysis of variables and the achievement of Key Performance Indicators (KPIs). The flow of information, data, and performance measurement processes were designed into Business Intelligence (BI) software development i.e. BI-MonevDash. The framework and software BI-MonevDash proposed can be used as a new chosen tool for measuring and monitoring organizational performance. Recommendations could facilitate the leaders in decision making to improve the organizational performance and reduce risks.

3. Mentor's Comment #3 : Introduction

Are there researches that showed that incorporating AHP really produces better results? How to make certain that the result is better (measurement)?

It seems that AHP and OMAX has been combined before in previous work. Then what are the contributions of the current paper?

In the end of Introduction, the authors should tell the reader what is being accomplished in the paper, how it is different from previous work, and what are the contributions of the paper.

Respond to Comment #3 :

Has been discussed with mentor and revise the introduction based on mentor suggestion in file PDF. 9648 comments

1. Introduction

The demand for competitive advantages and business boosters forces an organization to constantly monitor, evaluate and manage strategies as an effort to improve the achievement of management performance. These management strategies are especially related to the quality of business performance measurement [1]. This measurement activity is necessary to identify the organization condition through the analysis of its operational strengths and weaknesses [2]. Root cause and effect analysis of each activity can be analyzed to minimize the risk that might occur. The fault in management decisions can also be evaluated directly as a corrective action from every operational process which takes place in the organization. Herein the role of performance measurement tools become very important in measuring impacts, influences, and triggering the organization activities periodically.

Previous researchers have studied several performance measurement tools such as Balanced Scorecard (BSC), The European Foundation for Quality Management (EFQM) Business Excellence Model, Performance Measurement Matrix, Performance Pyramid, Performance Prism, and Kanji Business Excellence Management System (KBEMS). Amongst the above methods, BSC and EFQM Business Excellence Model are the most widely used of performance management system. These models provide a structured approach in recognizing the possible strategy changes and threats. In addition, they are capable of translating the corporate strategy into targets which lead to a more detailed and affordable action plan [1]. However, several reviews found that BSC and Performance Pyramid are two of the best models for strategically measuring Performance Measurement Factors (PMFs). Organizations can use those models to clarify goals, set strategic goals and communicate the selected strategies. Meanwhile, the EFQM Business Excellence Model is more appropriate to use in benchmarking

processes. Performance Prism and KBEMS were developed as the completion of BSC. However, various deficiencies are still found in both models, especially during the implementation of strategy measurement [1].

In the previous decade, BSC has been adopted by many forms of organization, profit or nonprofit. It showed that 44% of the organizations feel significant satisfaction in the results [2]. BSC has advantages over other models, especially when presenting the performance dimensions from a different perspective to improve the organization's business outcomes in present and future [3]. In addition, BSC has the power to outline the clarity, synergy, and consistency of vision, mission and organizational strategy from corporate to the individual level. The monitoring and evaluation process of each strategy can be controlled periodically and are flexible against any changes and improvements that occur. During the integration of the performance measurement process, the cross-platform communications are well established. This indirectly triggers the formation of knowledge creation and acquisition between level management actors. However, several weaknesses were found, particularly those related to the scorecard determination process and its analysis estimation [1]. Estimation is often generated based on managers' views as a person in charge when determining the scorecard number, thus the significance, subjectivity, and detailed analysis are bias. AHP is one of the methods that is introduced in this research to overcome the weakness of scorecard estimation in BSC.

AHP is a method that combines the qualitative and quantitative assessment method so it can overcome the shortcoming of a single qualitative or quantitative assessment method [4]. Some previous studies applied this concept including Lee et al. in [5]. They implemented the integration of AHP fuzzy and BSC approach while evaluating the organizational performance manufacturing company in Taiwan [5]. Bhattarai in [6] studied the diffusion of AHP and BSC in Nepal [6]. Erbasi and Parlakkaya in [7] applied AHP and BSC in a Hotel Firm [7]. Finally, Feili et al. in [8] tried to integrate AHP with BSC in Information Technology industries [8]. The integration of AHP method in BSC can overcome the weakness of BSC in the subjectivity of managers or key actors assessment [5,8]. AHP through the forming pairwise comparison matrix is capable to generate the increase of redundancy and reduce some errors. This method provides the decision-making process which considers the aspects of experience, intuition, and actual data [9]. Another research from Yuhong in [10] that attempts to integrate BSC with another method, it proposed a novel balanced scorecard design based on fuzzy Analytical Network Process (ANP) for performance evaluation. The experimental result showed that the design was quite effective [10]. This becomes the main reasons to apply the AHP concept of BSC measurement in this research. However, this integration found several limitation that related to the number of comparisons and environment analysis thus restricted to AHP specifications and rules [9].

In order to complement AHP scorecard estimation, this research applied OMAX through the calculation of overall multi-factor performance index. Herein, OMAX as one of productivity measurement systems is used to monitor the company's productivity based on the alignment of criteria to strategic objectives [11]. Therefore, each criterion can be measured by its level of effectiveness and efficiency. Matrix performance indicators are then scales and categorized into several values of groups such as very bad, poor, medium, good, and very good. This authorizes the stakeholders to track the status or performance of KPI and normalized them mathematically into a single score of performance measurement [12]. The score allows management to identify the strategy performance changes [13]. The role of OMAX is used to normalize and convert the value of BSC performance measurement into a performance index [14]. The integration of BSC and OMAX can describe the overwhelming data and provides the analysis to become more measurable, unambiguous, normal and accurate [15,12].

To automate the integration of BSC measurement, AHP weighting analysis, and the OMAX scoring processes, an application namely BI-MonevDash was then developed. BI is able to facilitate the formation of appropriate strategies as well as associate them with the performance measurement frameworks applied; enable decision makers to take corrective actions, and adopt new management initiatives and new strategies. Integration of BI and BSC is an innovative method that can support the decision making in management level and provide an opportunity for them to act in accordance with the conditions and circumstances occurred [3]. BI is not only able to display BSC

structure but also the result of analysis using graphical demonstration such as a graph, dashboard, and strategy map [3] so that the cascading of strategic objectives are clearly identified. Previous studies have proven that BI is the most successful method of presenting and following the performance measurement using BSC concept [3,16,17]. Herein four BSC perspectives are explained in more detail and measurable. Recommendations are given as corrective action against the performance achievements. This will aid management level in decision making, monitoring and evaluating performance periodically. To scope this research, a case study is conducted at University X based on data reported in 2015

4. Mentor's Comment #4 : Method

Section 2 (Research Method in the paper) is not required in scientific publication, even though it is needed in thesis. What is needed is a detailed description of the proposed method. However, in the paper the authors call this results and analysis. Please correct this.

3.1, 3.2, 3.3, 3.4, and 3.5 are actually description of the proposed method. However, the authors focus more on the case study instead of the explanation of their proposed method.

Respond to Comment #4 :

Has revise the method as mentor suggestion.

For the purpose of implementing this research, several stages were developed as depicted in Figure.1.

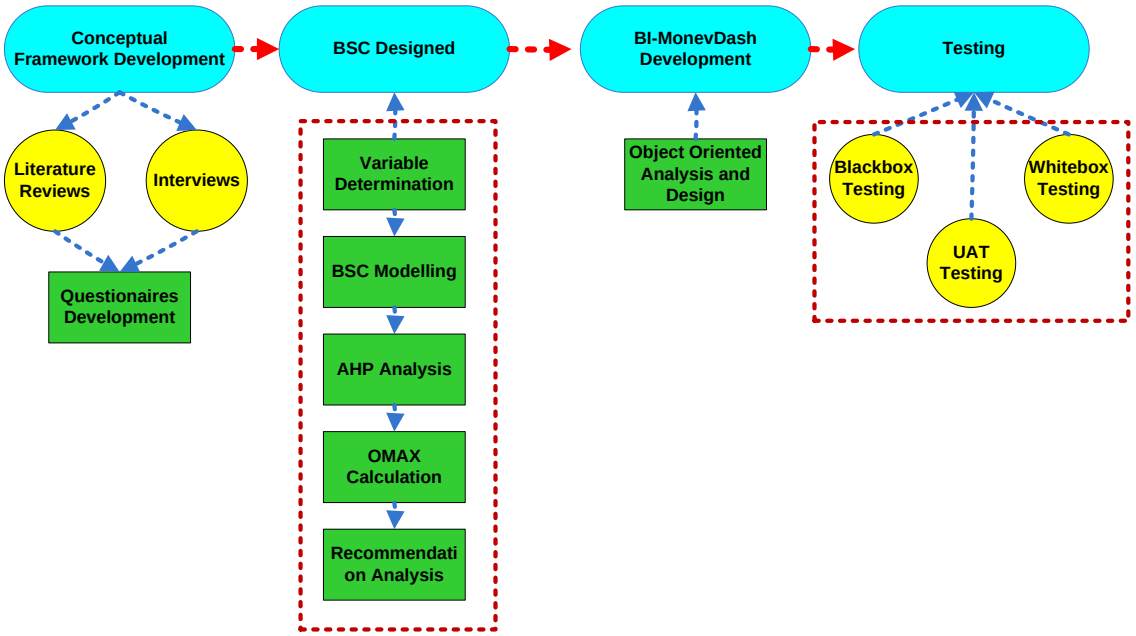

Figure 1. Proposed Research Methodology

Conceptual Framework was developed based on the reviewing of several literatures and conducting interviews. A case study in an X University with four persons employed as Dean and Deputy Dean was accomplished towards the development of questionnaires as instruments. Some information from the case study was obtained including organizational business process data, organizational structure, organizational strategic plan 2013-2033 and operational plan and organizational achievement 2013-2018, performance documents and portfolio. Three questionnaires were designed and distributed to the above University. The first questionnaire aimed to validate strategic target variables which were formulated based on the organization's vision and mission. Herein, a 5-scale Linkert was applied as an optional choice of respondents agreed. As the result, twenty variables were proposed in four perspective of BSC. Meanwhile, the second questionnaire was used to determine the weight or significance level of each variable through the application of AHP method. Twenty variables were tested and compared thus then ranked based on the significance level and weight. The third questionnaire was used to set the performance targets and achievements of twenty variables. These questionnaires were answered by management level from top to middle in accordance with the desired targets and consideration of previous year achievements.

Next step, BSC design was developed in several phases [2], including Collection and Documentation of Current System; Balanced Scorecard Modelling; Determining Measurement Values in AHP analysis and OMAX calculation; and Analysis Report for recommendation. Herein, manual analysis of BSC, AHP, and OMAX concepts was transformed into automated BI-Monevdash. BI-Monevdash followed Object Oriented model for Analysis and Design. UML was used as a tool in describing the interaction between objects into the development of use cases, class diagrams, and activity diagrams. This BI-Monevdash then was tested using black-box, white-box, characteristic test and User Acceptance Test (UAT).

5. Mentor's Comment #5 : Result and Discussion

This section is missing from the paper. There is supposed to be a section called Results and Analysis where the proposed method and its implementation is assessed and evaluated. Is the output good? Is it providing better results? How to determine that the result is better?

It is not enough to propose a method and apply it to a case study. Scientific publication requires authors to compare it to existing methods and techniques. These are all missing from the paper.

Respond to Comment #5 :

Has been revised as mentor suggestion.

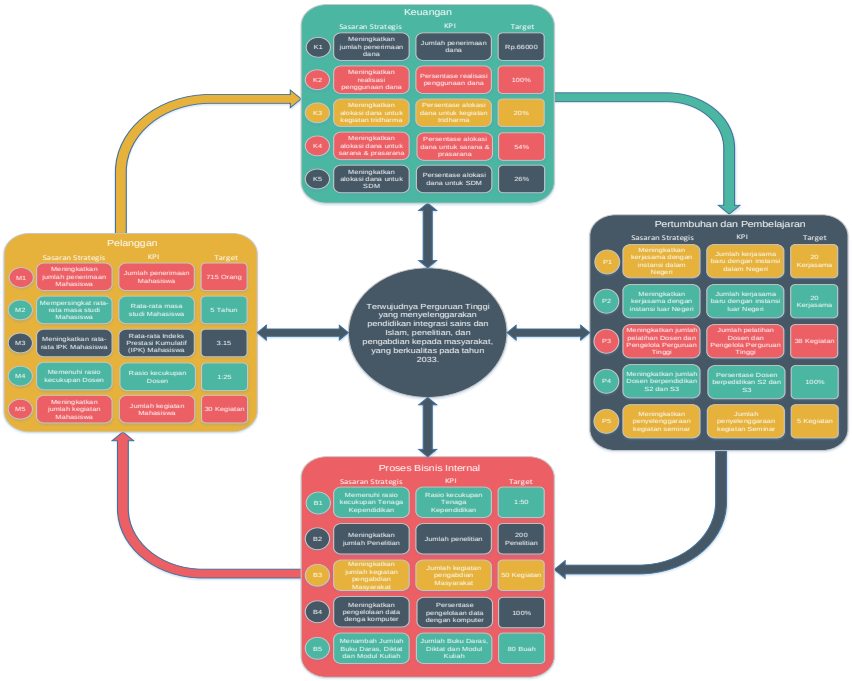

Figure 2. BSC Modelling

As mention before, 20 variables were derived from each BSC perspective and thus acted as strategic objectives. For BSC-Financial perspective, there were five variables, namely FST-01: Increasing the amount of budget allocation, FST-02: Maximizing the realization of budget, FST-03: Increasing budget allocation for Tridharma Perguruan Tinggi (Teaching, Research and Community Services), FST-04: Increasing budget allocation for facilities and infrastructure, and finally FST -05: Increasing budget allocation to improve the quality of human resources and development. Detailed variables were explained in Figure 2. The above variables were

verified and justified through the analysis of the first questionnaire and can be accepted with an 88% agreeable percentage. Next, a cause and effect relationship between variables was mapped toward the strategic map as shown in Figure 3.

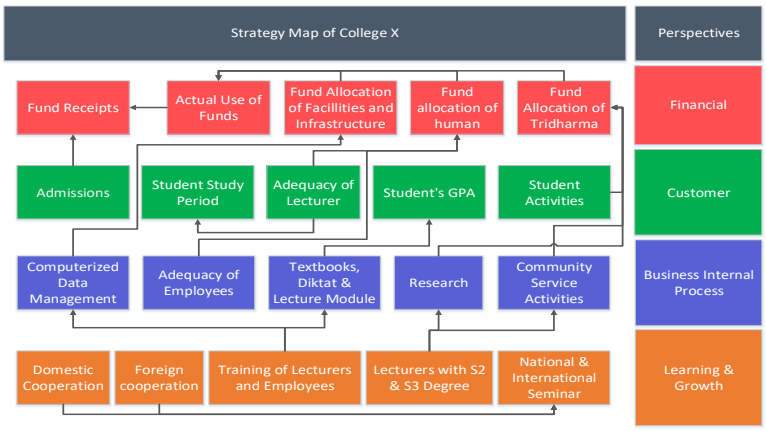

Figure 3. Strategy Map of X University

The strategy map explained that in learning and growth perspectives, the increasing of variable FST-16 (Enhancing the cooperation with internal strategic partners) and FST-17 (Improving cooperation with external strategic partners) affects the increase of FST-20 (Improving academic forums activities towards national and international conferences). The effects can be shown through the involvement of sponsorship, promotion, committee, participants, and keynote speakers which are very potential for the success of academic forums. The increasing number of training for employees and lecturers (FST-18) provided the significant values on the numbers of textbooks, modules as the outcome of the knowledge development activities. Then, increasing number of lecturers with master and doctoral degrees in FST-19 will influence numbers of research in FST-12 and number of community service activities (FST-13) which also triggers the increase of students' research activities in FST-10 and budget allocation for Tridharma in FST-03. Similar explanation provided in the Figure for other perspectives.

3.2. Determining the Measurement Value

Referring to the development and analysis of BSC modeling and the strategy map, it then continued by determining the measurement values using AHP calculation. As the result of the second questionnaire, the weights of each variable is measured in their significances. The result of Consistency Ratio (CR) and Consistency Index (CI) values are smaller than 0.1 which indicates that the overall perspectives and variables are accepted and consistent. The summarization of vector eigenvalue per perspectives and overall KPIs can be seen in Table 1. The significance of the BSC variables are analyzed and identified through the AHP application, creating a new contribution based on the company or organizations preferences.

Table 1. AHP Weighted and OMAX Scoring Level Summary of Perspectives

Perspective	Priority Value (Eigen Vector)	Variable	Priority Value (Eigen Vector)-Local	Priority Value (Eigen Vector)-Global	OMAX Level	Category	Index
Financial	0,195	FST-1	0,140	0,027	8	Very good	5,176 (Average)
		FST-2	0,118	0,023	0	Review	
		FST-3	0,184	0,036	5	Average	
		FST-4	0,140	0,027	2	Bad	
		FST-5	0,419	0,082	4	Average	
Customer	0,149	FST-6	0,055	0,008	3	Bad	7,873 (Good)
		FST-7	0,274	0,041	10	Perfect	
		FST-8	0,274	0,041	3	Bad	
		FST-9	0,321	0,048	7	Good	
		FST-10	0,077	0,011	10	Perfect	
Internal Business Process	0,231	FST-11	0,108	0,025	3	Bad	4,544 (Average)
		FST-12	0,388	0,090	5	Average	
		FST-13	0,138	0,032	0	Review	
		FST-14	0,165	0,038	10	Perfect	
		FST-15	0,201	0,046	3	Bad	

Learning and Growth	0,425	FST-16	0,134	0,057	0	Review	3,22 (Bad)
		FST-17	0,154	0,065	6	Good	
		FST-18	0,187	0,079	5	Average	
		FST-19	0,311	0,132	3	Bad	
		FST-20	0,214	0,091	2	Bad	

Table 1 explained that from four BSC perspectives, learning and growth became the highest significance perspective with the eigenvector value in 0.425, followed by the internal business process perspective in 0.231, financial perspective in 0.195 and customer perspective in 0.149. Meanwhile, the weighting for each perspective is also defined according to local and global vector eigenvalues.

Based on the local vector eigenvalues in financial perspectives, FST-05 provided the highest significance weight (0.419) and FST-02 as the lowest one (0.118). For customer perspectives, FST-09 became the highest essential weight in 0.321 and FST-06 as the lowest one in 0.055. For the internal business process perspective, FST-12 provided the uppermost considerable weight in the 0.388 and FST-11 as the undermost one in 0.108. For growth and development perspectives, FST-19 became the uppermost significant weight in 0.311 and FST-16 as the bottommost significant weight in 0,134. Based on the global vector eigenvalues, FST-19 became the superior priority weight in 0,132 and FST-6 as the inferior one in 0.008.

Complementing BSC and AHP analysis, the calculation of scoring with OMAX was accordingly conducted to carry on the analysis. By applying the OMAX's leveling formula: $\Delta \boldsymbol{X_{L-H}} = \frac{\boldsymbol{Y_H - Y_L}}{\boldsymbol{X_H - X_L}}$, the interval values between high to low level ($\Delta \boldsymbol{X_{L-H}}$ **)** can be defined through the calculation of value in high level ($\boldsymbol{Y_H}$), low level ($\boldsymbol{Y_L}$), level in high ($\boldsymbol{X_H}$**)** and level in low ($\boldsymbol{X_L}$). OMAX scheme was leveled into 10 scales [18] which defined the possible factors that influencing the performance in terms of predefined KPI. The scale of achievement was in accordance with targets. Scale 0 as the lowest performance achievement; 3 shows the average achievement; and 10 as the maximum target achievement. Meanwhile, scales 1 and 2 are obtained from the calculation of interpolation values at scales 0 and 3. The result will be the values of intervals from scale 0 to 3. Scale 4-9 are obtained from the calculation of interpolation values in scale 3 and 10 and will be used as intervals values between scale 3 to 10 [19]. Finally, the index row was derived from the total calculation of performance indicator.

Recapitulation on the calculation values, scoring levels, categories, and performance index was obtained based on data reported in 2013, 2014 and 2015 which is compared to target value achievements in 2016. Table 1 found that the performance index of X Unversity in financial perspective lies in the "average" category with a weight index in 5.176. The customer perspective stands in the "good" category with weight index is 6.744. The internal business process perspective is in the "average" category with weight index in 4.544. Finally, the growth and learning perspective is in the "bad" category with weight index is 3.22. The average overall performance at X University is at a score of 5 with an "average" performance index. As of, the level performance achievement of each variables and sub variables was then quantitatively measured in accurate numbers analysis. Herein, the OMAX fulfills the limitation of AHP and BSC for estimation analysis.

By rooting the cause and effect analysis of each KPIs and performance index achievement, the recommendations were proposed as shown in Table 2. This table explained the recommendation for performance index lies on categories in “bad” and “review”. As an example, FST-02 which category is in “review” found that the achievement of budget realization is 100%. The recommendation proposed management level to maintain this achievement. The FST-04 performance index in the “bad” category was due to the reduction of budget allocation achievement for facilities and infrastructures. The strategy changes to subsidize the budget for Tridharma. As a recommendation, the management level needs to stay focus on organizational and strategic objectives thus setting the budget allocation in alignment with it.

Table 2. Root Cause and Recommendation

No KPI	Category	Root Causes	Recommendation
FST-2	Review	Percentage of funds utilization is at 100% or maximum	Maintain the realization of the use of funds at 100% percentage.
FST-4	Bad	The percentage of allocation of funds for facilities and infrastructure was reduced to increase the percentage of fund allocation for *Tridharma* and human resources activities.	Increase fund allocation for the development of *Tridharma* and human resources activities.
⋮	⋮	⋮	⋮
FST-20	Bad	The number of national and international seminars has not increased significantly.	Increase the number of national and international seminars to develop and disseminate knowledge of the academic community of UIN Suska FST.

3.3. Analysis and BI-Monevdash Design

BI-Monevdash application is built by following the entire stages in BSC, AHP, and OMAX. Mechanism of BSC analysis and modeling which is then integrated with AHP for KPIs weighting and OMAX for performance index measurement become the main components in BI-Monevdash development. The architecture diagram informed the flow data process transaction in and out components and key actors for every level stages. Any data such a perspective analysis data, strategic target data, strategy maps, interest values data, organizational profiles, user data, weighted results data, and process, and scoring data are restored and managed in knowledge base repository in connection with the server. The server is developed by applying apache components and MySQL database. The connection to a client PC, web browser, and serial printers supported server activities. The users are involved as key actors in this application are divided into three categories, namely middle manager including the head of the administration office, head of department and secretary as a person in charge. The software administrator acts as system operator. Meanwhile, the top manager is dean and deputy dean. This application is designed to be as interactive as possible by allowing users to interact directly or indirectly in the monitoring and evaluating progress on the performance. The recommendations and corrective action was given as an evaluation, management control and to reduce the emerging risks during the strategy execution. Performance measurement, process, and result analysis are reported in forms of Gauge, Bar chart, Line chart, table, and dashboard model.

3.5. Method Testing through BI-Monevdash Application Test

White-box testing was conducted using several techniques such as a flowgraph, Cyclomatic Complexity (CC) calculation, independent path determination, and a test case. From 55 nodes, the flowgraph obtains the systematic complexity value that is running 11 test cases thus indicates that BI-Monevdash application has a complex procedure and moderate risk. This test cases value interprets that white box testing is a success. In Black-box testing, equivalence class partitioning technique was conducted thus the entire functions in the application can run as well as expected. Finally, dashboard characteristic testing was conducted to determine the feasibility and specification of the system towards dashboard characteristics. The testing was conducted by disseminating the questionnaire to several top and middle managers as respondents. The questionnaire applied scale Linkert 5. As the result, 89% of respondents strongly agree with the suitability of BI-Monevdash system with dashboard characteristics. As well as UAT testing proposed the result that BI-Monevdash application can be well-accepted by end-users. The testing result informed that the involvement of overall stakeholders as end users from top to middle managers in determining the significances of variables in AHP analysis, through their operational data entry and perceives has proven can enrich the BSC estimation analysis as well as managers' views. Detailed information given by OMAX leveling has aided end users in identifying the performance level of each variables and sub variables. Therefore, the accurate analysis of organizational performance level was quantitatively explained.